**Human Activity Blamed in Reversal of Cooling in Arctic**

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Scientists walk on an iceberg, 36 metres above the water surface of Kane Basin August 6, 2009. A team of scientists are onboard the Arctic Sunrise ship for the first leg of Greenpeace's three-month-long Arctic Impacts expedition. The expedition aims to document the effects of climate change on the Arctic environment, ahead of the Copenhagen summit which will be held in December 2009. (Nick Cobbing - Reuters)

Human-generated greenhouse gas emissions have helped reverse a 2,000-year trend of cooling in the Arctic, prompting warmer average temperatures in the past decade that now rank higher than at any time since 1 B.C., according to a new study published Thursday in the online version of the journal Science.

The analysis, based on more than a dozen lake sediment cores as well as glacier ice and tree ring records from the Arctic, provides one of the broadest pictures to date of how industrial emissions have shifted the Arctic's long-standing natural climate patterns. Coupled with a [separate report](http://www.worldwildlife.org/what/wherewework/arctic/arctic-climate-feedbacks.html) on the region issued Wednesday by the World Wildlife Fund, the studies suggest human-induced changes could transform not only the Arctic but climate conditions across the globe.

"It's basically saying the greenhouse gas emissions are overwhelming the system," said David Schneider, a visiting scientist at the National Center for Atmospheric Research and one of the Science article's co-authors.

The historical study involved 30 researchers from the United States, Britain, Denmark, Norway, Canada and Finland and reconstructs the Arctic's climate in the distant past. The World Wildlife Fund, by contrast, published a forward-looking report detailing how current warming there is likely to shift global weather patterns and affect agriculture, forestry and water supplies in the United States, Europe and elsewhere. The lead author of the WWF report, Martin Sommerkorn, said recent Arctic warming "has triggered effects that will come back and affect the rest of the world, in terms of climate change."

The paper in Science sheds light on several key scientific questions, including how the earth's orbital pattern around the sun affects our climate, and the extent to which current computer climate models mirror real-world conditions. Some climate skeptics have argued that the fact that the earth wobbles in its axis of rotation has helped determine recent warming, rather than human activities. But the new study shows this wobble -- which affects how much sunlight the earth receives in the middle of the summer -- actually accounts for a long-term cooling trend in the Arctic, which has only been reversed in the past half-century.

Northern Arizona University professor Darrell S. Kaufman, the study's lead author, notes this rotation means the earth was 620,000 miles closer to the sun in mid-summer 2,000 years ago, and continues to move farther away. The cooling trend that resulted, he said, "should have continued through the twenty-first century." Instead, summer temperatures in the Arctic are now 2.5 degrees Fahrenheit warmer than they would have been expected to be under the natural cycle.

Until now, the most comprehensive paleo-climate analysis of the Arctic covered just the past 400 years. The new analysis reaches back further in time by incorporating data from six new lake sediment cores. Unlike glaciers or tree ring samples, Arctic lakes are more widely distributed throughout the region, so they can provide a more comprehensive look at the area's past. Researchers were able to analyze everything from annual glacier melt to how much algae grew in an ice-free season, Kaufman said.

John Smol, Canada research chair in environmental change and an Arctic lake expert, said the region's lake sediments act as "a black box for the ecosystem" because they remain pristine and contain both biological and physical data that has accumulated every year. "You still have some of these natural laboratories," Smol said. "We have really strong barometers of what's happening in the Arctic."

Mark Serreze, director of the National Snow and Ice Data Center at the University of Colorado at Boulder, said the study was significant because it helps confirm scientists' current understanding of how the earth's climate has changed over millennia.

"It's not that we don't know how the climate works, it just we didn't have anyone at that time measuring the climate forcing then," referring to 2,000 years ago. "Climate doesn't change all by itself for no good reason. Something has to force it."

Fred Singer, a prominent climate change skeptic who heads the Science and Environmental Policy Project, questioned the Science study on the grounds it does not properly reflect the fact that other researchers have found the Medieval Warm Period -- which lasted between 800 and 1,300 A.D. -- had "higher temperatures than even the past 30 years." But documentation of the Medieval Warm Period is primarily about Europe, and natural records indicate average Arctic temperatures during that time were not as high. There was a brief period in the early fifth century that came close to, but was not quite as warm, as the Arctic's most recent summer temperatures.

Robert Correll, who chairs the Arctic Climate Impact Assessment, said the paper in Science will likely "in the long haul become a seminal piece in the scientific literature" because it allows other climate researchers "to set their work in a long time scale."

The group's findings also meshed with current computer modeling of how Arctic temperatures have changed over time. Kaufman noted this gives researchers "confidence in our predictive abilities" to model future warming in the Arctic and other parts of the globe.

Sommerkorn said unless countries make a concerted effort to cut their emissions in the next few decades, higher Arctic temperatures could release a massive amount of greenhouse gases from its permafrost and contribute to a warmer world in other aspects because less sea ice means it will not be able to reflect as much sunlight in the future. "If we don't do it, and do it now, we can really not keep these Arctic feedbacks under control in the coming decades," he said.